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(54) Title: CONDUCTIVE OR STATIC DISSIPATIVE COATING

(57) Abstract

Electrically conductive or static dissipative coating, films, or laminae in a laminate construction suitable for packaging of sensitive electronic components. The electrical conductive or static dissipative properties are achieved by including an effective amount of a quaternary ammonium compound into a base resin.

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CONDUCTIVE OR STATIC DISSIPATIVE COATING

Background of the Invention

1. Field of the Invention

This invention relates to a film, specifically a self-sustaining film or a laminae in a laminated construction or a coating for such laminated construction which is electrically conductive and/or possesses static electricity dissipative properties. These materials can be used especially to package electronic components which may be affected by or damaged by the build-up of static electricity during transportation, handling or storage of the electronic part.

2. Background of the Invention

Resinous materials, e.g. polymeric materials, are known to be useful for formation of coatings, self-sustaining films, laminae in laminated constructions and coating thereon. However, inherent in the use of polymeric materials is the fact that they are typically non-conductive to electricity and, in fact, such materials are used widely as insulators because of these non-conductive properties.

Prior attempts at imparting electrically conductive properties to polymers include the inclusion of conductive materials, especially a material such as carbon or similar material, e.g. graphite, as a filler to the polymeric material. The inclusion of a material such as carbon is only effective if it is provided in such an amount (by weight or volume) and dispersed uniformly throughout the polymeric material so as to form a continuous pathway for transmission of electrical energy. The inclusion of such large amounts of filler and the problem of uniformly dispersing a material such as carbon greatly influences the conductive properties of the resulting composite material. Due to its nature, i.e. its inherent color, the use of carbon also imparts a predominately black color to any polymeric material into which it is incorporated in electrically conductive amounts.

Therefore, there is a requirement in the packaging industry for materials which are more aesthetically pleasing than a black plastic film.

Summary of the Invention

A film or coating which is composed primarily of a polymeric material is provided with conductive or static dissipative properties having particular utility for packaging electronic components, which are subject to deterioration of properties by build-up of static electricity during storage, shipping and handling and/or electrically conductive materials in a form of a self-sustaining film, as a laminae in a laminated construction or as a coating on paper or in a laminated construction for the purpose of imparting conductive or static dissipative properties to the polymeric material. Such polymeric material having the conductive or static dissipative properties can be used as packaging materials, especially for packaging electronic components.

Detailed Description of the Preferred Embodiments

Polymeric materials such as acrylic based polymers, especially methylmethacrylate containing polymers, are excellent for forming coatings and films because of their physical properties, especially their optical clarity. These properties make it desirable to use such materials as a component for packaging after manufacture. However, such polymeric materials do not conduct or transmit electrical energy and are generally known as "insulators," i.e. are non-conductive to electrical current.

The present invention discloses a novel formulation for imparting electrical conductivity or static dissipative properties to polymeric materials by mixing between about 1 to about 10 wt % of a material imparting a surface resistivity (as measured by ASTM D-257 test method conducted at 12% relative humidity) so as to have a static dissipative property of less than 10^{12} ohms/sq and a conductive property of less than 10^{5} ohms/sq. A material suitable for mixing with

the polymeric material is a quaternary ammonium compound. These quaternary ammonium compounds, in a solvent/carrier of an alcohol, preferably an isopropanol/ethanol mix, results in a liquid material which is easily mixed with the polymeric material. The quaternary ammonium containing liquid preferably contains about 41% by weight alcohol and most preferably 40% isopropanol and 1% ethanol. Quaternary ammonium salts have been used as softeners, especially in laundry formulations, or as applied to paper or foam substrates introduced during drying of laundered clothes. However, no use of these materials as a component of a film, laminate or coating has been known prior to the invention. A suitable material can be obtained from ACL Inc., 1960 E. Devon Avenue, Elkgrove Village, Illinois 60007, under the name "STATICIDE 3000G." Such a material is commercially available in liquid concentrate form appearing as a clear yellow substance with a pleasant odor, having an evaporation rate greater than water. As sold, "STATICIDE 3000G" has a specific gravity of 0.97, a density (g/ml) of 0.97, a vapor pressure (mm) at 20°C of 36 and a vapor density of 2.1. Percent volatiles (by volume) is about 40% with a pH of 7.1±1.

After mixing the quaternary ammonium containing liquid with the polymeric material, the resulting composition can then be formed into a self-sustaining film or used as a laminae of a lamination construction or as a coating for paper or a lamination construction. When used in a lamination construction, the conductive or static dissipative containing material of the present invention should preferably be used as the outer layer, i.e. on one or both sides of the film. Between the outer layers of the film, additional laminae may include a metallicized or non-metallicized surface and one or more layers of plastic film, fabric, non-woven material or paper, each of which is either coated or non-coated with coatings. The mixture of quaternary ammonium containing liquid and other components can be formed into a film. applied as a

coating or formed into a laminae by conventional techniques known to the art for making other polymeric films, coatings and/or laminae.

Typical requirements of a self-sustaining film would be one having a thickness between about 0.5 to about 500 mils and having a tensile strength (measured by ASTM D-882 test method of 0-100 lbs. per square inch). Puncture resistance (as measured by FTMS 101C method 2065) is 0-150 lbs. The haze (as measured by ASTM D-1003 test method) is clear to opaque; an optical density (measured by the McBeth test method) of 0-4.0% and a light transmission (measured by ASTM D-1003 test method) of 0-100%. Seam strength of a film made into a package as tested by ASTM D-882 test method should destruct.

The best mode contemplated by the inventor for carrying out the invention is illustrated by the following examples:

Example 1 (all parts being by weight)

Parts	Component
27.0	H_2O
2.6	NH_4OH 28°
336.0	Joncryl 82*
74.0	Joncryl 61**
29.8	Jonwax 28***
15.0	Zinc Oxide Solution****
120.0	H_2O
3.0 - 60.0	Staticide 3000G

*Methylmethacrylate aqueous solution sold by S.C. Johnson & Sons, Inc., U.S. Specialty Chemicals, 1525 Howe Street, Racine, Wisconsin.

**Methylmethacrylate aqueous solution sold by S.C. Johnson & Sons, Inc., U.S. Specialty Chemicals, 1525 Howe Street, Racine, Wisconsin.

***A polyethylene wax emulsion containing about 35% solids sold by S.C. Johnson & Sons, Inc., U.S. Specialty Chemicals, 1525 Howe Street, Racine, Wisconsin.

****Actually a dispersion of zinc oxide particles in an aqueous vehicle.

Example 2

Parts	Component
400.0	Spectra-Guard 763*****
110.0	H2O
4.0 - 20.0	3000-G Staticide Concentrate

Example 3

Parts	Component
400.0	Spectra-Guard 763
110.0	H2O
4.0-20.0	3000-G Staticide Concentrate
5.0-25.0	Joncryl 89******

The foregoing examples illustrate a conductive material content of between about 1 to about 10% by weight sufficient to form a coating, a self-sustaining film and/or a laminae in a laminated construction providing the surface resistivity mentioned above.

The chemical properties including the property of contact corrosivity as measured by FTMS 101C method 3005 showed no visible sign after testing of deterioration; has an ion content (sodium, fluoride, phosphate and sulfate ions) below detectable levels and is amine and amide free.

It will be apparent to those skilled in the art that I have provided a formulation which permits the attainment of a coating, film or laminated construction based primarily on a polymeric system which is static dissipative and/or conductive to electrical energy, permitting the formulation of aesthetic packaging materials, especially for packaging electronic parts which

*****A film forming material commercially available from Spectra-Kote Corporation, Fourth Street and East Water Street, Gettysburg, Pennsylvania and described in U.S. Patents 5,393,566 and 5,531,863, the entire disclosures of which are herein incorporated by reference.

******Sold commercially by S. C. Johnson & Sons, Inc., U.S. Specialty Chemicals, 1525 Howe Street, Racine, Wisconsin.

can be damaged by static electricity during storage, shipping and/or handling. However, it will be apparent to those skilled in the art that other formulations and uses thereof could be employed without departing from the spirit and scope of the invention.

We claim:

1. A conductive polymeric composition comprising an acrylic resin base containing a quaternary ammonium compound in an amount of about 1 to about 10 wt % based on the weight of the composition to impart a static dissipative property and a conductive property to said polymeric composition.

2. The conductive coating composition of claim 1, wherein said acrylic resin is a methylmethacrylate containing polymer.

3. The conductive coating of claim 1, further comprising a dispersion of zinc oxide particles.

4. The conductive coating of claim 3, further comprising a polyethylene wax emulsion.

5. A coating formed from the conductive polymeric components of claim 1.

6. A self-sustaining film formed from the conductive polymer composition of claim 1.

7. A paper layer coated with the conductive polymeric composition of claim 1.

8. A laminate comprising two or more laminae coated on at least one surface of a laminae with the conductive polymeric composition of claim 1.

9. A package comprising a layer of the conductive polymeric composition of claim 1, in combination with a material selected from the group consisting of paper, fabric, non-woven material, plastic film and combinations thereof.

10. The package of claim 9, wherein said at least one material comprises a metallized surface.

11. A method of converting electrically insulative polymeric material into conductive material without inclusion of carbon, graphite or metallic components, said method comprising incorporating an electrically conductive effective amount of a quaternary ammonium compound into the polymeric material.

12. The method of claim 11, wherein said incorporating includes the step of introducing said quaternary ammonium compound in the form of an alcohol solution into the polymeric material.

13. The method of claim 12, wherein the alcohol solution comprises a mixture of isopropanol and ethanol.

14. The method of claim 11, wherein the amount of quaternary ammonium compound is between about 1 and about 10 wt %.

AMENDED CLAIMS

[received by the International Bureau on 24 July 2000 (24.07.00) ;
original claims 1-14 replaced by new claims 1-14 (2 pages)]

1. A self-sustaining film comprising a composition including an acrylic resin base containing a quaternary ammonium compound in an amount of about 1 to about 10 wt % based on the weight of the composition to impart a static dissipative property and a conductive property to said film.

2. The self sustaining film of claim 1, wherein said acrylic resin is a methylmethacrylate containing polymer.

3. The self sustaining film of claim 1, further comprising a dispersion of zinc oxide particles.

4. The self sustaining film of claim 1, further comprising a polyethylene wax emulsion.

5. A paper layer coated with a conductive polymeric composition comprising an acrylic resin base containing a quaternary ammonium compound in an amount of about 1 to about 10 wt % based on the weight of the composition to impart a static dissipative property and a conductive property to said paper layer.

6. The paper layer of claim 5, wherein the said acrylic resin is a methymethacrylate containing polymer.

7. The paper layer of claim 5, further comprising a dispersion of zinc oxide particles.

8. The paper layer of claim 5, further comprising a polyethylene wax emulsion.

9. A laminate comprising two or more laminae coated on at least one surface of a laminae with a conductive polymeric composition comprising an acrylic resin base containing a quaternary ammonium compound in an amount of about 1 to about 10 wt % based on the weight of the composition to impart a static dissipative property and a conductive property to said laminate.

10. A package comprising a layer of a conductive polymeric composition comprising a composition including an acrylic resin base containing a quaternary ammonium compound in an amount of about 1 to about 10 wt % based on the weight of the composition to impart a static dissipative property and a conductive property to said polymeric composition, in combination with a material selected from the group consisting of paper, fabric, non-woven material and combinations thereof.

11. The package of claim 10, wherein said at least one material further comprises a metallized surface.

12. The package of claim 10, wherein the material is paper.

13. The package of claim 12, further comprising a dispersion of zinc oxide particles.

14. The package of claim 12, further comprising a polyethylene wax emulsion.

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H01B 1/20; B32B 27/20
US CL : 252/500; 428/357, 409, 922; 08/115.6
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 252/500; 428/357, 409, 922; 08/115.6

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WEST (search terms include: pmma, polymethylmethacrylate, antistat$, electroconduct, quaternary ammonium)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 4,895,886 A (FELTER et al) 23 January 1990, see Abstract; Summary; Col 2, lines 47-65; Col 3, lines 10-15.	1-5, 11-14
X	US 4,662,514 A (BERBECO) 05 May 1987, see Abstract; Col 4, lines 22-60; claims.	1-5, 9-11
A	US 5,597,675 A (ARUDI et al) 28 January 1997, see Abstract; Col 4, lines 10-15.	1-14
A	US 4,379,822 A (SHAW) 12 April 1983, see Abstract; Col 2, lines 35-60.	1-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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